HIGHER HUMAN BIOLOGY: Assignment

Resource Pack: Ebola – a viral disease

In this assessment learners have to investigate a relevant topic in biology and communicate their research findings in a report. The suggested topic relates to a key area of the Higher Human Biology Course.

The assignment assesses the following skills, knowledge and understanding:
• applying knowledge of biology to new situations and analysing information
• selecting information from a variety of sources
• presenting information appropriately in a variety of forms
• processing the information/data collected (using calculations and units, where appropriate)
• drawing valid conclusions and giving explanations supported by evidence/justification
• evaluating experimental/practical investigations
• communicating findings/information effectively

UNIT - IMMUNOLOGY and PUBLIC HEALTH

Area of the curriculum

3 The transmission and control of infectious diseases
(a) Infectious diseases caused by pathogens, transmitted by direct physical contact, water, food, body fluids, inhaled air or vector organisms and controlled by quarantine, antisepsis, individual responsibility (good hygiene, care in sexual health and appropriate storage/handling of food), community responsibility (quality water supply, safe food webs and appropriate waste disposal systems) and vector control.
(b) Epidemiological studies of infectious diseases.
Description of spread to include sporadic (occasional occurrence), endemic (regular cases occurring in an area), epidemic (unusually high number of cases in an area) or pandemic (a global epidemic). Control measures to include preventing transmission, drug therapy, immunisation or a combination of these.

This resource pack provides information on:
1. Background Information: the key facts about the Ebola virus, its structure, its transmission and the prognosis of those infected
2. The history of past Ebola outbreaks
3. Transmission of the Ebola virus
4. Signs and symptoms of Ebola Virus Disease
5. Diagnosis of Ebola Virus Disease
6. Treatment of Ebola Virus Disease
7. Prevention and control; including controlling Ebola virus in animals and public health messages
BACKGROUND INFORMATION

The following link gives updated information about Ebola:
http://www.who.int/mediacentre/factsheets/fs103/en/

Key facts:

- Ebola virus disease (EVD), previously known as Ebola haemorrhagic fever, is a severe, often fatal illness in humans.
- Ebola (EVD) was discovered in 1976 and the viruses which cause the disease are members of the family of viruses known as Filoviridae.
- Each virion contains one molecule of single-stranded, non-segmented, negative-sense viral RNA.
- Five Ebola subtypes have been identified. Four of the five have caused disease in humans. Ebola virus (Zaire ebolavirus); Sudan virus (Sudan ebolavirus); Tai Forest virus (Taï Forest ebolavirus, formerly Côte d'Ivoire ebolavirus); and Bundibugyo virus (Bundibugyo ebolavirus). The fifth, Reston virus (Reston ebolavirus), has caused disease in nonhuman primates, but not in humans.
- EVD outbreaks have a case fatality rate of up to 90%.
- EVD outbreaks occur primarily in remote villages in Central and West Africa, near tropical rainforests.
- The virus is transmitted to people from wild animals and spreads in the human population through human-to-human transmission.
- Fruit bats of the Pteropodidae family are considered to be the natural host of the Ebola virus.
- Severely ill patients require intensive supportive care. No licensed specific treatment or vaccine is readily available for use in people or animals.

HISTORY

The Ebola virus was first associated with an outbreak of 318 cases of a haemorrhagic disease in Zaire (now the Democratic Republic of Congo) in 1976. Of the 318 cases, 280 people died and in the same year 284 people in Sudan became infected with the virus and 151 of them died.

The outbreak in Zaire was in a village near to the Ebola River and so the disease was named after the river. The following link shows a table of the chronology of all the Ebola outbreaks throughout the world:

http://www.cdc.gov/vhf/ebola/resources/outbreak-table.html

The table also refers to the particular subtype of the virus which was involved in each outbreak. A recent outbreak began in March 2014 in Guinea and northern Liberia and then spread to eastern Sierra Leone and Nigeria – by August 2014 over 1,000 people were infected.
TRANSMISSION

Scientists researching the Ebola virus think that initially Ebola is introduced into the human population through close contact with the blood, secretions, organs or other bodily fluids of infected animals. In Africa, infections appear to have been transmitted through handling infected chimpanzees, gorillas, fruit bats, monkeys, forest antelope and porcupines which were found ill or dead or in the rainforest. 
http://www.who.int/mediacentre/factsheets/fs103/en/

Ebola is then often spread through families and friends because they come in close contact with infectious secretions when caring for the ill person. The disease can spread quickly within clinics or hospitals particularly where hospital staff are not wearing appropriate protective equipment, such as masks, gowns, and gloves. Burial ceremonies in which mourners have direct contact with the body of the deceased person can also play a role in the transmission of Ebola. Men who have recovered from the disease can still transmit the virus through their semen for up to 7 weeks after recovery from illness. Health-care workers have frequently been infected while treating patients with suspected or confirmed EVD. This has occurred through close contact with patients when infection control precautions are not strictly practiced.
http://www.msf.org.uk/article/ebola-we-take-precautions

SIGNS AND SYMPTOMS

The initial symptoms of EVD are quite non specific. They include fever, intense weakness, muscle pain, headache and a sore throat often followed by vomiting, diarrhoea, rash, impaired kidney and liver function, and in some cases, both internal and external bleeding. At this stage blood tests will show low white blood cell and platelet counts and raised liver enzymes. People are infectious as long as their blood and secretions contain the virus. Ebola virus was isolated from semen 61 days after onset of illness in a man who was infected in a laboratory. The time interval from infection with the virus to onset of symptoms (incubation period), varies from 2 to 21 days.
Table showing symptoms of EVD:

<table>
<thead>
<tr>
<th>Symptoms of EVD include</th>
<th>Additionally some patients may experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fever</td>
<td>• A rash</td>
</tr>
<tr>
<td>• Headache</td>
<td>• Red eyes</td>
</tr>
<tr>
<td>• Joint and muscle aches</td>
<td>• Hiccups</td>
</tr>
<tr>
<td>• Weakness</td>
<td>• Cough</td>
</tr>
<tr>
<td>• Diarrhoea</td>
<td>• Sore throat</td>
</tr>
<tr>
<td>• Vomiting</td>
<td>• Chest pain</td>
</tr>
<tr>
<td>• Stomach pain</td>
<td>• Difficulty breathing</td>
</tr>
<tr>
<td>• Lack of appetite</td>
<td>• Difficulty swallowing</td>
</tr>
<tr>
<td></td>
<td>• Bleeding inside and outside of the body</td>
</tr>
</tbody>
</table>

**DIAGNOSIS**

Diagnosing Ebola Virus Disease can be difficult because many of the symptoms, such as fever, red eyes and a skin rash, are not specific to EVD infection and are common in patients with more commonly occurring diseases such as malaria. However, if a person in an area of an outbreak of EVD presents with symptoms, the person should be isolated and public health professionals notified. Samples from the patient can then be collected and tested to confirm infection.

Laboratory tests used in diagnosis include:

<table>
<thead>
<tr>
<th>Timeline of Infection</th>
<th>Diagnostic tests available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within a few days after symptoms begin:</td>
<td>• Antigen-capture enzyme-linked immunosorbent assay (ELISA) testing</td>
</tr>
<tr>
<td></td>
<td>• IgM ELISA</td>
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<td></td>
<td>• Polymerase chain reaction (PCR)</td>
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<td></td>
<td>• Virus isolation</td>
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<tr>
<td>Later in disease course or after recovery:</td>
<td>• IgM and IgG antibodies</td>
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<tr>
<td>Retrospectively in deceased patients:</td>
<td>• Immunohistochemistry testing</td>
</tr>
<tr>
<td></td>
<td>• PCR</td>
</tr>
<tr>
<td></td>
<td>• Virus isolation</td>
</tr>
</tbody>
</table>

Table from Centers for Disease Control and Prevention (CDC):


Samples from patients are an extreme biohazard risk and testing must be conducted under maximum biological containment conditions (UK Government guidelines on maximum biological containment conditions: http://www.hse.gov.uk/pubns/web09.pdf).
TREATMENT

No specific treatment is available for Ebola Virus Disease. New drug therapies are being evaluated but none are readily available for patients. The current way in which most patients are treated is to try to reduce their symptoms by:

- balancing their fluids and electrolytes
- maintaining their blood oxygen levels and their blood pressure
- treating them for any infections

An interactive guide showing an Ebola treatment centre where you can follow the patients and the health care professionals through the treatment centre is available at http://www.msf.org.uk/ebola

Some experimental treatments have been tested and shown to be effective in animal models and there is great hope that they will be effective in humans (see http://www.bbc.com/news/health-28663217).

No licensed vaccines for EVD are available. Several vaccines are being tested and there is a rush to move them into clinical trials in 2014 (see http://www.biorsearchonline.com/doc/NIH-works-with-FDA-to-fast-track-ebola-vaccine-to-clinical-trials-0001).

PREVENTION and CONTROL

Trying to control the spread of Ebola Viral Disease is not a straightforward task. When cases of the disease appear, there is increased risk of transmission within the hospital or clinic. Health care workers must be able to recognize a case of EVD and be ready to take practical viral hemorrhagic fever isolation precautions or barrier nursing techniques. They should also have the capability to request diagnostic tests or prepare samples for shipping and testing elsewhere.

Barrier nursing techniques include:

- wearing of protective clothing (such as masks, gloves, gowns, and goggles)
- the use of infection-control measures (such as complete equipment sterilisation and use of disinfectant)
- isolation of EVD patients from contact with unprotected persons.

The aim of all of these techniques is to avoid contact with the blood or secretions of an infected patient. If a patient with EVD dies, it is equally important that direct contact with the body of the deceased patient be prevented. A set of guidelines has been developed to help prevent and control the spread of EVD. The guidelines are entitled; Infection Control for Viral Hemorrhagic Fevers in the African Health Care Setting, and can be found at: http://www.cdc.gov/vhf/abroad/vhf-manual.html.
The guidelines in the manual describe how to:

- recognise cases of viral hemorrhagic fever
- prevent further transmission in health care setting by using locally available materials and minimal financial resources.

**Ebola virus in animals**

Non-human primates, such as chimpanzees and gorillas, have been a source of infection for humans but they are not thought to be the reservoir. They are an accidental host in the same way that human beings are.

One of the Ebola sub types Reston virus (*Reston ebolavirus* or RESTV) has caused severe EVD outbreaks in macaque monkeys farmed in Philippines and has been detected in monkeys imported into the USA and Italy from the Philippines.

RESTV viruses have been detected during several outbreaks of a deadly disease in pigs in People’s Republic of China and in the Philippines. No animal vaccine against RESTV is available. Routine cleaning and disinfection of pig or monkey farms (with sodium hypochlorite or other detergents) should be effective in inactivating the virus. Farms should be quarantined immediately if an outbreak is suspected. Culling of infected animals, with close supervision of burial or burning of carcasses, may be necessary to reduce the risk of animal-to-human transmission. Restricting or banning the movement of animals from infected farms to other areas can reduce the spread of the disease.

Pig farms in Africa can play a role in the increase in infection because of the presence of fruit bats on these farms. Appropriate biosecurity measures should be in place to limit transmission. For RESTV, educational public health messages should focus on reducing the risk of pig-to-human transmission as a result of unsafe animal husbandry and slaughtering practices, and unsafe consumption of fresh blood, raw milk or animal tissue. Gloves and other appropriate protective clothing should be worn when handling sick animals or their tissues and when slaughtering animals.

Public Health messages

The World Health Organisation and the Centers for Disease promote the following educational public health messages during an outbreak of EVD:

- Reducing the risk of wildlife-to-human transmission from contact with infected fruit bats or monkeys/apes and the consumption of their raw meat. Animals should be handled with gloves and other appropriate protective clothing. Animal products (blood and meat) should be thoroughly cooked before consumption.
- Reducing the risk of human-to-human transmission in the community arising from direct or close contact with infected patients, particularly with their bodily fluids. Close physical contact with Ebola patients should be avoided. Gloves and appropriate personal protective equipment should be worn when taking care of ill patients at home. Regular hand washing is required after visiting patients in hospital, as well as after taking care of patients at home.
- Communities affected by Ebola should inform the population about the nature of the disease and about outbreak containment measures, including burial of the dead. People who have died from Ebola should be promptly and safely buried.

General information about Ebola can be found at:

http://www.cdc.gov/vhf/ebola/index.html

http://www.who.int/mediacentre/factsheets/fs103/en/

http://www.msf.org.uk/ebola

News articles about the 2014 Ebola Viral Disease outbreak:

http://www.sciencedaily.com/releases/2014/08/140805163310.htm


http://www.ibtimes.co.uk/ebola-outbreak-it-safe-travel-by-plane-1460074 (Ebola spreading via air travel)

http://www.independent.co.uk/news/world/africa/ebola-outbreak-british-experts-urge-us-and-who-to-give-africans-experimental-cure-9650937.html (who will the experimental medicines be available to?)